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U.S. Nuclear Regulatory Commission
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Subject: Waterford 3 Steam Electric Station
Docket No. 50-382
License No. NPF-38
60-Day Response to NRC Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors

Dear Sir or Madam:

By letter dated June 9, 2003, the NRC requested licensees to provide a 60-day response to the subject bulletin that contains information requested in Option 1 or Option 2. Option 2 requested licensees to describe any interim compensatory measures that have been implemented or that will be implemented to reduce the risk which may be associated with potentially degraded or nonconforming emergency core cooling system (ECCS) and containment spray system (CSS) recirculation functions until an evaluation to determine compliance is complete.

On behalf of Waterford 3 (W-3), Entergy is providing the following requested information for Option 2:

- **Provide operator training on indications of and responses to sump clogging**

  Entergy will train licensed operators on indications of and responses to ECCS sump clogging. The training will include identification of indications, possible responses, Emergency Operating Procedure (EOP) and Severe Accident Management Guideline (SAMG) instructions for responding to ECCS sump clogging. In addition, consideration will be given for a simulator scenario that

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includes ECCS sump clogging indications and response. Due to the time needed for development, conduct, and scheduling, this training will be completed by March 31, 2004.

W-3 does not have operator training specific to ECCS sump clogging. However, operator training addresses the monitoring of operating ECCS and CSS pumps for indications of pump distress or loss of net positive suction head (NPSH), such as erratic current, flow, or discharge pressure. Training will be enhanced to emphasize the instrumentation available to identify symptoms of ECCS sump blockage or degraded pump performance. General symptoms of pump distress (erratic current, flow, or discharge pressure) could be used in combination with ECCS sump level to diagnose ECCS sump blockage. Operators have the following information available to them in order to determine the potential of ECCS sump blockage:

- ECCS sump level
- high pressure safety injection (HPSI) pump flow
- HPSI pump discharge pressure
- HPSI pump current
- CSS pump flow
- CSS pump discharge pressure
- CSS pump current
- containment pressure

- **Implement procedural modifications, if appropriate, that would delay the switchover to containment sump recirculation (e.g., shutting down redundant pumps that are not necessary to provide required flows to cool the containment and reactor core, and operating the CSS intermittently)**

  Entergy's procedures delay switchover to the ECCS sump recirculation to the extent practical. The EOPs provide direction in accordance with CEN-152, Combustion Engineering Emergency Procedure Guidelines to throttle or stop safety injection flow if certain conditions are satisfied (e.g., reactor coolant system sub-cooling, pressurizer level). Operator training reinforces the need for timely actions to throttle or stop flow. Potential changes to the guidance in CEN-152 are being evaluated by Westinghouse. Procedure changes have not been implemented at this time because detailed evaluations must be performed to ensure that operator actions to stop ECCS/CSS trains, throttle

pump flow, or other steps to delay switchover do not result in conditions that are inconsistent with design basis analyses. Strategies for safety injection throttling or stopping and containment spray termination have been reviewed and approved by the NRC in the SER on CEN-152. As such, they cannot be changed without a thorough review (10CFR50.59 evaluation including an assessment of misidentification of the event). W-3's current process for revisions to the EOPs is to evaluate and then incorporate (those deemed appropriate) recommendations from Westinghouse. This process would apply to any future recommendations.

Pre-emptive operator actions to throttle flow or stop pumps solely for the purpose of delaying switchover to ECCS sump recirculation are not recommended until the impact of the changes can be evaluated on a generic basis for the following reasons:

- Operator actions to stop ECCS or CSS pumps or throttle flow may result in conditions that are either outside of the design basis safety analysis assumptions or violate the design basis safety analysis assumptions (single failure). This would result in the potential for creating conditions that would make the optimal recovery more challenging (e.g., stopping containment spray impacts fission product removal, containment sump pH, and equipment environmental qualification design basis requirements).

- These actions would be inconsistent with the overall EOP philosophy. CEN-152 does not include an optimal recovery strategy or guidance that specifically addresses a set of symptoms indicative of ECCS sump clogging following Recirculation Actuation System (RAS) initiation (this situation would be considered a beyond design basis event). The current philosophy for EOPs provides for symptom-based responses that provide for the monitoring of plant parameters and prescribe actions based on the response of those parameters rather than diagnosing a specific condition such as ECCS sump clogging. To avoid the risk of taking an incorrect action for an actual event, the EOPs do not prescribe contingency actions until symptoms that warrant those contingency actions are identified.

- These actions would be inconsistent with the current operator response using the EOPs that has been established through extensive operator training. The expected operator response is based on the optimal set of actions considering both design basis accidents and accidents outside the design basis. The EOP operator response is not limited to a specific accident progression in order to provide optimal guidance for a wide range of possible accidents.

- To be effective in delaying the switchover to ECCS sump recirculation, operator actions to stop ECCS or CSS pumps must be taken quickly during a design basis accident. This introduces a significant opportunity for operator errors based on other actions that may be required during this time frame. Any new operator actions to stop ECCS or CSS pumps may result in increased risk due to operator error.

Furthermore, Los Alamos National Lab has performed a risk assessment of various recovery actions that could be taken by plant operators in the event of debris-induced ECCS sump failure. The analysis is reported in LA-UR-02-7562 (K. T. Kern and W. R. Thomas, "The Impact of Recovery From Debris-Induced Loss of ECCS Recirculation on PWR Core Damage Frequency," Los Alamos National Laboratory, Feb. 2003). In this analysis, shutting down redundant pumps as a recovery *during recirculation* for a debris-blocked ECCS sump was credited, since the resulting reduced flow would reduce the pressure loss through a clogged ECCS sump screen and possibly restore NPSH margin. For this case, the action (in response to ECCS and/or containment spray failure as a result of debris-blockage of the ECCS sump) is clearly beneficial and consistent with safety, i.e., the recovery of a failed safety system. The Los Alamos risk assessment estimates that this recovery, along with other recoveries, could measurably reduce the risk from debris-induced ECCS sump failure. The compensatory action recommended in NRC Bulletin 2003-01, however, is to preemptively shut down redundant pumps (not needed for providing required flows) during the injection mode in order to delay recirculation. This is not the same as the action modeled in the above Los Alamos risk assessment.

Shutting down ECCS or CSS pumps increases risk because in the case of a failure of an operating pump, operator action would be required to restart the secured pump, and the pump being restarted would be subject to the potential for another demand failure (subsequent to the initial demand in response to an ESFAS actuation). The operator failure probability for a medium or large LOCA could be significant, given the short time available.

- **Ensure that alternative water sources are available to refill the refueling water storage tank or to otherwise provide inventory to inject into the reactor core and spray into the containment**

  Although alternative water sources are not utilized in the EOPs, tools and guidance exist in the SAMGs to support recovering a source of make up to the RCS to prevent or mitigate core damage. The EOPs would continue to be used in conjunction with the SAMGs. The strategy at this point would be to replenish the RWSP from all available sources or provide an alternate source to supply ECCS by bypassing the RWSP as soon as possible.

  Numerous additional borated water sources are available for injection by either the HPSI pumps or the charging pumps including any remaining boric acid makeup tank (BAMT) inventory after recirculation actuation signal (RAS), RWSP inventory after RAS (10%), transfer of any excess spent fuel pool (SFP) inventory to the RWSP, transfer of any holdup tank inventory to the RWSP, and batch additions to the BAMTs. Additionally, the volume control tank can be manually unisolated and its remaining volume could be injected by the charging pumps. Unborated water may be added to the SFP from any excess condensate storage pool inventory or by the fire protection system to then provide additional diluted but still borated makeup to the RWSP. As a last resort, pure unborated makeup water can be provided directly to the suction of the charging pumps or to the RWSP for injection by the HPSI pumps.

  In parallel with the implementation of the EOPs by operations, management in the emergency response organization, i.e., the technical support center (TSC), would be called on to provide guidance and recommendations in accordance with emergency plan implementing procedures using guidance in the SAMGs. As a compensatory measure, Entergy will enhance the ability to ensure that alternative water sources are available to refill the RWSP or to otherwise provide inventory to inject into the reactor core and/or spray into the

containment by adding appropriate guidance to emergency plan implementing procedures and/or the SAMGs by March 31, 2004. This enhancement will ensure strategy and guidance is available for refilling the RWSP. This may include prioritizing sources and flow paths, any necessary preplanning, emergency equipment staging and training.

Significant additional injection sources using the EOPs are not recommended due to equipment flooding concerns. W-3's maximum post-LOCA containment flood level is conservatively calculated based on maximum indicated RWSP water level. The calculated maximum flood level is just below the containment fan cooler fan blades. Therefore, alternative water sources are not available in the EOPs to refill the RWSP without impacting the W-3 containment fan coolers.

For the design basis accident (DBA), ECCS sump temperatures will increase. This will result in a small reduction in required NPSH per the guidance of NUREG-0897. For less severe accidents, required NPSH would be reduced further. Also, while the W-3 Safety Injection sump and ECCS pumps were not designed around crediting the "increase in containment pressure" during accident conditions (i.e., the design meets Regulatory Guide 1.1) for the DBA, containment overpressure during this entire accident provides a large increase in NPSH available.

- **Implement a more aggressive containment cleaning and increased foreign material controls**

  Entergy implements a proceduralized containment building closeout process that ensures no loose debris (rags, trash, plastic, wood, scaffolding, clothing, etc.) is present in containment following an outage that could be transported to the ECCS Sump and cause restriction of pump suctions during LOCA conditions. Items authorized to remain in containment during power operations are verified to be in their evaluated locations. A site procedure is utilized to verify the containment building is ready for heatup and power operations. This procedure meets technical specification surveillance requirements and commitments for containment inspection requirements. Once the containment building is ready for closeout, operations personnel inspect containment for any loose debris to ensure no loose debris remains which could be transported to the ECCS sump.

Entergy proceduralizes the Foreign Material Exclusion (FME) Program to prevent inadvertent introduction of foreign materials into plant systems and components. The highest order of FME is applied to the ECCS sump and refueling cavity. If during an outage the ECCS sump or refueling cavity are accessed, foreign material exclusion controls are implemented, and items taken into and out of the these areas are logged. Furthermore, any work or activity performed in containment on or near an open structure, system, or component includes appropriate FME controls.

As part of the coating inspections performed every refueling outage, the concrete floors and walls, and structural steel members, surrounding the ECCS sump on each elevation are inspected. Failed coatings, that could become dislodged and fall in the vicinity of the ECCS sump are repaired prior to start-up. To minimize the potential for sump clogging, transient items are not stored near the ECCS sump.

Provisions are in place per site procedures to maintain the post-outage conditions should a containment building entry be required while at power or during a brief forced outage. In these cases, the responsible groups verify that the areas of the containment building affected by the entry have no loose debris present which could be transported to the ECCS sump.

- **Ensure containment drainage paths are unblocked**

Entergy performs a thorough ECCS sump closeout inspection during refueling outages in accordance with a site procedure. During this inspection, the ECCS sump inlets are verified to be unrestricted and free of debris. ECCS sump components are inspected for evidence of structural distress or corrosion.

Due to the design of W-3's containment building, the majority of the water freely flows down to the ECCS sump by bypassing grating on each of the elevations. Drainage paths exist in the refueling cavity where water must pass through valves in order to reach the ECCS sump. These valves are verified by operations at the end of the refueling outage to be locked open in order to ensure drainage from the refueling cavity. Entergy will inspect these lines and other drain lines that could affect drainage paths during future outages to ensure that these lines are unobstructed.

The refueling cavities are designated as foreign material exclusion (FME) zones in which the most stringent controls are applied. FME controls preclude items from being left in the cavity which could obstruct the drainage path.

- **Ensure sump screens are free of adverse gaps and breaches**

  After major work in containment is completed and equipment has been properly stored, the ECCS sump closeout inspection is performed in accordance with a site procedure. During this inspection, the ECCS sump screens are inspected to ensure no openings in the ECCS sump screen, or around the screen penetrations are larger than the screen mesh size. The screen mesh is sized to ensure that there are no detrimental effects on the safety injection system, containment spray system, or nuclear steam supply system.

  Furthermore, the following information is provided on the design of the ECCS sump and sump screen. The ECCS sump is located such that there are no high energy systems in the vicinity of the ECCS sump and therefore damage to the ECCS sump and screens by whipping pipes or high velocity jets is prevented by separation. The ECCS sump is bounded by concrete shield walls on the east, west, and north sides, and by the containment vessel on the south. These walls shield the ECCS sump from high energy systems from which missiles can be generated.

  Debris is prevented from entering the ECCS sump by a grating floor directly above the ECCS sump, angle iron located at the base of the screen, and by Trisodium Phosphate baskets which are located on the north and south sides of the ECCS sump. Also, the floor level in the vicinity of the sump slopes down away from ECCS sump which prevents high density particles from moving towards the SIS sump.

  The ECCS sump is covered by a robust and rugged screen cage structure in the form of a rectangular box. The screen cage is comprised of structural steel members comprised of relatively short stiff wide flanges and angles. The screen is attached to the exterior side of the support frame by bolts spaced at frequent intervals.

The ECCS sump screen and members are designed based on the calculated pressure differential across the screen due to pump suction and screen resistance. Review of the calculation indicates that there is considerable margin in the size of the members selected. Due to the stainless steel wire mesh's ability to withstand gross elongations before rupture, the screen wires would act as catenaries and withstand the loading of design head at maximum flood level in the event of considerable screen blockage.

The chance of blockage of the ECCS sump screen at W-3 is reduced by the fact that there is no calcium-silicate type insulation inside the containment building. Insulation containing calcium-silicate has been shown to be a significant contributor to post-LOCA ECCS sump screen blockage. The types of insulation in the containment building are metal reflective, metal encapsulated, and nuclear blanket type thermal material.

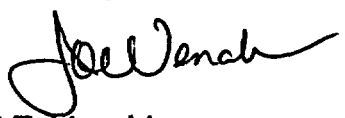
Entergy is monitoring and participating in industry efforts to address the potential concerns for sump blockage. Entergy expects to begin the data collection for debris generation this year.

All of the commitments contained in this submittal are identified on the attached Commitment Identification/Voluntary Enhancement Form.

Should you have any questions concerning this submittal, please contact Mr. Greg Scott at (504) 739-6703.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 7, 2003.

Sincerely,



J.E. Venable
Vice President, Operations

JEV/GCS/cbh
Attachment: Commitment Identification/Voluntary Enhancement Form

cc: T.P. Gwynn, (NRC Region IV), N. Kalyanam, (NRC-NRR)
J. Smith, N.S. Reynolds, NRC Resident Inspectors Office

COMMITMENT IDENTIFICATION/VOLUNTARY ENHANCEMENT FORM

Attachment 1 to W3F1-2003-0050
60-Day Response to NRC Bulletin 2003-01, Potential Impact of Debris Blockage on Emergency Sump Recirculation at Pressurized-Water Reactors
August 7, 2003

COMMITMENT(S)	ONE-TIME ACTION*	CONTINUING COMPLIANCE*	SCHEDULED COMPLETION DATE (IF REQUIRED)	ASSOCIATED CR OR ER
Entergy will train licensed operators on indications of and responses to ECCS sump clogging. The training will include identification of indications, possible responses, Emergency Operating Procedure (EOP) and Severe Accident Management Guideline (SAMG) instructions for responding to ECCS sump clogging. In addition, consideration will be given for a simulator scenario that includes ECCS sump clogging indications and response. Due to the time needed for development, conduct, and scheduling, this training will be completed by March 31, 2004.		yes	3/31/2004	
In parallel with the implementation of the EOPs by operations, management in the emergency response organization, i.e., the technical support center (TSC), would be called on to provide guidance and recommendations in accordance with emergency plan implementing procedures using guidance in the SAMGs. As a compensatory measure, Entergy will enhance the ability to ensure that alternative water sources are available to refill the RWSP or to otherwise provide inventory to inject into the reactor core and/or spray into the containment by adding appropriate guidance to emergency plan implementing procedures and/or the SAMGs by March 31, 2004. This enhancement will ensure strategy and guidance is available for refilling the RWSP. This may include prioritizing sources and flow paths, any necessary preplanning, emergency equipment staging and training.		yes	3/31/2004	
Due to the design of W-3's containment building, the majority of the water freely flows down to the ECCS sump by bypassing grating on each of the elevations. Drainage paths exist in the refueling cavity where water must pass valves in order to reach the ECCS sump. These valves are verified by operations at the end of the refueling outage to be locked open in order to ensure drainage from the refueling cavity. Entergy will inspect these lines and other drain lines that could affect drainage paths during future outages to ensure that these lines are unobstructed		yes		

*Check one only